REPORT OF THE INTERNATIONAL X-RAY UNIT COMMITTEE

During the recent meeting of the Second International Congress of Radiology, held in Stockholm, Sweden, July 23 to 27, 1928, the Convenor of the International X-ray Unit Committee, E. A. Owen, called to order the International X-ray Unit Committee for the purpose of discussing and perhaps reaching an agreement regarding the standardization of X-ray measurements. Two delegates had been appointed by each of the following countries to attend this meeting, one a physicist and one a radiologist, representing, respectively, Austria, Belgium, Bulgaria, Czecho-Slovakia, Denmark, France, Germany, Great Britain, Greece, Holland, Hungary, Italy, Japan, Norway, Russia, Spain, Sweden, Switzerland, and the United States of America.

The report of the Standardization Committee of the Radiological Society of North America, made at New Orleans in 1927, is fundamentally similar to the one recommended by this International X-ray Unit Committee, as follows:

The International X-ray Unit Committee has come to unanimous agreement regarding the standardization of X-ray measurement, and forwards to the Meeting of the Delegates of the Second International Congress of Radiology the following proposals for endorsement and promulgation:

(1) That an International Unit of X-radiation be adopted.

(2) That this International Unit be the quantity of X-radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber is avoided, produces in one cubic centimeter of atmospheric air at 0° C. and 76 cms. mercury pressure, such a degree of conductivity that one electrostatic unit of charge is measured at saturation current.

(3) That the International Unit of X-radiation be called "The Roentgen" and that it be designated by the letter small "r."

(4) That various standard methods be employed to establish the unit.

(5) That for all comparative purposes it is advisable to employ ionization chambers which have been calibrated in terms of a standard chamber for X-radiation of the various qualities employed. It is also advisable to make the wall effects of these chambers as small as possible.

(6) That the practical instrument used to measure X-ray output be called a dosage-meter (*Dosismesser, dosimètre*).

(7) That the constancy of the indications of the dosage-meter be tested by means of gamma radiation emitted from a definite quantity of radium element, the measurement being carried out always under the same conditions.

(8) That any specification of dosage is incomplete without specifying the quality as well as the quantity of the radiation. The quality of X-radiation used for practical purposes varies widely and it would be impracticable to give a complete specification of it, but much information can be obtained from a knowledge of the degree of absorption of the radiation in standard materials, the peak voltage applied to the tube together with the filter employed, and the general character of the high tension apparatus.

For practical purposes the quality may be expressed by stating the half value layer in a suitable material, or by stating the effective wave length as determined by the percentage amount of radiation transmitted through a given thickness of a suitable material (copper or aluminium).

In view of the fact that rapid progress is being made in methods of X-ray measurements and in our knowledge of X-ray phenomena, the Committee feels that the above

recommendations should be regarded as being of a provisional character.

MANNE SIEGBAHN, *Chairman.*
E. A. OWEN } *Honorary*
H. HOLTHUSEN } *Secretaries.*

Stockholm, Sweden
July 25, 1928.

The above report is respectfully submitted for publication.

WILLIAM DUANE, PH.D.
EDWIN C. ERNST, M.D.
Representatives to the International X-ray Unit Committee

COMMUNICATION

CONCERNING THE COMMERCIAL EXHIBIT

To the Members of the Radiological Society of North America:

I wonder if you are fully appreciative of the enormous amount of help that the exhibitors in the Commercial Exhibits have been to our Society.

If you have supposed that the Society, its journal, its meetings, and its numerous other activities could be maintained solely from your dues paid into the treasury, it is because you have not paused to consider.

Up to the end of the coming meeting in Chicago, the commercial exhibitors will have contributed a sum considerably in excess of $30,000 for exhibit space at the twenty-two meetings of the Society, every dollar of which has gone toward paying some of the Society's expenses. You have in some way or other received benefit from that $30,000, and it is my suggestion that you show your appreciation by visiting every exhibit at the Drake Hotel during the coming meeting. See every exhibit and tell every exhibitor that you appreciate his co-operation. Tell all of the exhibitors that we want them to continue to help us, and show them by your words and actions that you share in the Society's appreciation of their long continued interest and support.

The following 27 firms have bought space in the Drake Hotel Commercial Exhibit:

Abbott Laboratories, North Chicago, Ill.
Acme-International X-ray Co., Chicago
Geo. W. Brady & Co., Chicago
Britesun, Inc., Chicago
Buck X-Ograph Co., St. Louis, Mo.
Cameron's Surgical Specialty Co., Chicago
Chicago X-ray Film & Mount Co., Chicago
Cooper & Cooper, Inc., New York City
Davies, Rose & Co., Ltd., Boston, Mass.
Eastman Kodak Company, Rochester, N. Y.
Engeln Electric Company, Cleveland, O.
French Screen Company, Detroit, Mich.
General X-ray Company, Boston, Mass.
Hanovia Chemical & Mfg. Co., Newark, N. J.
Horlick's Malted Milk Corporation, Racine, Wis.
Kelley-Koett Mfg. Co., Inc., Covington, Ky.
Medical Protective Co., Chicago
Middlewest Instrument Co., Chicago
National Aniline & Chemical Co., Inc., New York City
Patterson Screen Co., Towanda, Pa.
Picker X-ray Corporation, New York City
Radiographscope Co., Greensboro, N. C.
Standard X-ray Company, Chicago
Swan-Myers Company, Indianapolis, Ind.
Victor X-ray Corporation, Chicago
Waite & Bartlett Mfg. Co., Long Island City, N. Y.
Wappler Electric Company, Long Island City, N. Y.

I am sure that all will agree that the above list represents the good, the modern, and the up-to-date in American products of interest to American radiologists. *See every exhibit. Talk with all the exhibitors. Tell them that they have "put it over" handsomely.*

Yours for success,
I. S. TROSTLER, M.D.

stock and on a non-profit basis, "for the purpose of contributing such sums of money as the board of trustees may deem wise, and which the Foundation may possess in excess of its own requirements, to other institutions or individuals in the State of Virginia to be used under proper supervision exclusively for cancer research or for the diagnosis and treatment of indigent cancer patients."

"We hope," said Dr. Wright Clarkson, of Petersburg, Va., director, "to have several million dollars on hand within about ten years. . . . With whatever funds we may accumulate as we go along, we will do what we can for treatment of cancer victims in Virginia who are unable to pay, and we expect to contribute as best we can to organizations engaged in cancer research in the State."

Education of laymen in cancer prevention and early treatment, the Foundation will leave to organizations now engaged in that work.

Men and women prominent throughout the State are officers. Dr. J. Shelton Horsley, Sr., of Richmond, is chairman of the research committee.

RECOMMENDATIONS OF THE INTERNATIONAL COMMITTEE FOR RADIOLOGICAL UNITS (CHICAGO, 1937)

Introduction

Pursuant to the reference to gamma-ray dosage in the recommendations of the International Committee at its 1934 meeting at Zurich, it is now considered that sufficient evidence exists for the provisional adoption of a single unit, the roentgen, as the unit of quantity, not only for x-rays but also for gamma rays. To do this it is necessary to adopt a somewhat more generalized definition of the roentgen and this is given below. It is proposed that this definition be regarded as provisional and that a more exact definition to include all classes of radiation be prepared for the next Congress.

Section A: Units

1. The International Unit of *quantity* or *dose* of x-rays or gamma rays shall be called the "roentgen" and shall be designated by the symbol "r".

2. The roentgen shall be the quantity of x- or gamma-radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, ions carrying 1 e.s.u. of quantity of electricity of either sign. (See Appendix, Note 1.)

3. Measurements of radiation quantity shall be expressed in roentgens. Measurements of dosage rate shall be expressed in roentgens per minute.

Section B: Dose or the Specification of the Conditions of X-ray Treatment

4. In the description of the conditions of x-ray treatments, distinction shall be made between the quantity of radiation measured in air and the quantity of radiation estimated to have been received by the tissue. Since the symbol, r, is reserved for the unit, the amount of the dose may be designated by the letter D. The use of subscripts is suggested to distinguish dosage measurement made under different conditions; *e.g.*, in free air—D; at the surface of the skin (including back-scatter)—D_0, etc. (See Appendix, Note 2.)

5. The specifications of treatment conditions shall include the following:

I. *Quantity.*—The quantity of radiation (expressed in roentgens) estimated to have been received by the lesion.

II. *Quality.*—(*a*) The spectral energy distribution of x-radiation shall be designated by some suitable index, called quality. For most medical purposes it is sufficient to express the quality of the x-radiation by the half value layer in a suitable material: Up to 20 kv. (peak) cellophane or cellone; 20–120 kv. (peak) aluminum; 120–400 kv. (peak) copper; 400 kv. up (peak) tin. For a more definite specification of the quality of the radiation the complete absorption curve in the same material is preferable. (*b*) Material and thickness of filter, including tube walls. (*c*) Target material.

III. *Technic.*—(*a*) Total quantity of radiation per field (incident and emergent) received in an entire course of treatment. (*b*) Quantity of radiation per field measured at the surface (D_0) at each individual irradiation. (*c*) The dosage rate expressed in r/min. during each individual irradiation. (*d*) The total time over which a course of treatments is spread. (*e*) The time interval between successive doses. (*f*) The target-skin distance. (*g*) The number, dimensions, and location of the ports of entry.

Section C: Dose or the Specification of the Conditions of Gamma-ray Treatments

6. The specification of the conditions of gamma-ray treatments should, where possible, include statements of—

I. *Quantity.*—The total quantity of radiation (expressed in roentgens) estimated to have been received by the lesion.

II. *Particulars of Radium Source.*—(*a*) The total amount and nature of radio-active substance employed (expressed as equivalent mgm. of radium element). (*b*) Type, number, and distribution of the containers. (*c*) The material and thickness of filters and the nature of the material externally adjacent to the skin.

III. *Technic.*—(*a*) In the case of surface applicators or "large radium units," the quantity of radiation per field at the surface. (*b*) The dosage rate during each individual irradiation. (*c*) The total time over which a course of treatments is spread. (*d*) The time intervals between successive irradiations. (*e*) In the case of surface applicators or large radium units, the radium-skin distance. (*f*) The number, dimensions, and situations of the ports of entry.

Section D: Instruments

7. The following types of apparatus are suggested as suitable for the measurement of quantity in roentgens:

(*a*) *X-ray Primary Standards.*—The free air chamber shall be used for free air measurements for all wave lengths down to the practical limit set by the consideration that the chamber must be of such width and length that the full ionization produced by the corpuscular emission from air is measured in accordance with the definition. An air-wall chamber which meets the requirements of the definition may be used for harder radiations.

(*b*) *X-ray Practical Instruments.*—The air-wall chamber may be used for clinical measurements of x-ray quantity over the entire voltage range.

(*c*) *Gamma-ray Standards and Practical Instruments.*—The air-wall chamber may be used for the measurement of primary, scattered, or a combination of both radiations.

8. Instruments used to measure radiation quantity or dosage may conveniently be called dosemeters and dosage-rate (or dose-rate) meters, respectively, and shall be calibrated in roentgens or roentgens per minute.

9. The calibration readings of dosemeters and dosage-rate meters should be independent of the wave length within the range for which they are designed or used.

10. Dosemeters and dosage-rate meters should be provided with suitable arrangements (*e.g.*, standard radium source, Bronson leak, or capacity sharing device) for checking the reproducibility of their readings.

11. The calibrations of dosemeters or dosage-rate meters should be tested periodically by a recognized testing laboratory over the range of wave lengths for which they are designed or used.

12. The National Standardization Laboratories shall be invited to undertake standard measurement and the calibration of dosemeters relative to all forms of radiation therapy to which these recommendations may apply. They shall also be invited to issue joint reports from time to time thereon.

Section E: Appendix

Note 1.—Note that 0.001293 gram is the mass of 1 c.c. of dry atmospheric air at 0° C. and 760 cm. of mercury pressure.

Note 2.—For example, in an hypothetical case of medium x-rays,

The dose measured in air, D equals 300 r;

The dose measured at the surface, D_0 equals 500 r;

The dose measured at x cm. depth, D_x equals 200 r;

N.B., D is not to be confused with the energy actually absorbed by the tissue.

Section F: Rules Governing the Selection and Work of the International Committee for Radiological Units

13. The International Committee on Radiological Units shall be governed by the following rules:

(*a*) The International Committee on Radiological Units (I.C.R.U.) shall be composed of two representatives from each country sending delegates to the Congress. These representatives shall be chosen by the National Committee of Delegates for each country. However, any country having a National Standardization Laboratory may have three representatives, one of whom shall be appointed by such laboratory, but the representatives from a single country shall always include one radiologist and one physicist.

(*b*) The nominations of the above-named representatives of each country shall be communicated through the delegates of that country to the Secretary of the Executive Sub-committee of the International Committee on Radiological Units at least thirty months before the next Congress.

(*c*) In case new representatives shall not have been appointed or their nominations not have been furnished within the time and in the manner above specified, the former representatives shall be retained and considered to have been re-appointed. In the event of a representative being unable to attend the I.C.R.U. meetings, a substitute may be appointed by the national delegation through its chairman. Similar substitute appointments may be made by the directors of the National Laboratories.

(*d*) The continuance of the policies and records of the I.C.R.U. shall be in the hands of the standing Executive Sub-committee, consisting of six members elected by the I.C.R.U. from among the members of the whole Committee.

(*e*) The members of the Executive Sub-committee shall be elected to serve for terms of nine years each. The two senior members shall automatically retire at the end of each Congress but shall be eligible for re-election. A meeting of the I.C.R.U. shall be called on the first day of Congress to fill any vacancies existing in the Executive Sub-committee.

(*f*) The Executive Sub-committee of the I.C.R.U. shall elect its own Chairman and Secretary from among its members. The Secretary shall be custodian of all records and papers relating to the work of the Committee.

(*g*) The Executive Sub-committee shall familiarize itself with the progress in the field of dosimetry and prepare the program to be submitted to the main Committee for discussion. A preliminary report thereon shall be published and circularized to all members of the I.C.R.U. at least six months before the meeting of the Congress. The final agenda for the meeting shall be prepared by the Executive Sub-committee on the first day of the Congress. The Executive Sub-committee shall report to the I.C.R.U. on all matters presented to it.

(*h*) Meetings of the I.C.R.U. shall be presided over by the Chairman, selected from the country in which the Congress is held. He shall be assisted, as may be necessary, by the Executive Sub-committee.

(*i*) A résumé of any formal discussion presented at a meeting of the I.C.R.U. by any member must be submitted in writing by such member to the Secretary of the Executive Sub-committee before the same shall be accepted for inclusion in the minutes of the meeting.

Members of the Sub-committee

H. Behnken, *Chairman*, term, nine years;
L. S. Taylor, *Secretary*, term, nine years;
E. Pugno-Vanoni, term, six years;
I. Solomon, term, six years;
R. Sievert, term, three years;
F. L. Hopwood, term, three years.

Members of the International Committee for Radiological Units Preparing the Above Report

G. Failla, *Honorary Chairman*, U. S. A.,
I. Solomon, *Chairman*, France,
L. S. Taylor, *Secretary*, U. S. A.,
G. Schwarz, Austria,
J. Juul, Denmark,
H. M. Hansen, Denmark,
H. Holthusen, Germany,
H. Behnken, Germany,
W. Friedrich, Germany,
F. L. Hopwood, Great Britain,
G. W. C. Kaye, Great Britain,
N. S. Finzi, Great Britain,
A. Lambadarides, Greece,
D. den Hoed, Holland,
A. Bouwers, Holland,
M. Ponzio, Italy,
E. Pugno-Vanoni, Italy,
M. Tanaka, Japan,
K. Inouye, Japan,
J. Jovin, Roumania,
E. C. Ernst, U. S. A.,
R. R. Newell, U. S. A.

FIFTH INTERNATIONAL CONGRESS OF RADIOLOGY

The Fifth International Congress of Radiology has passed into history, more fully reported by the lay press of the United States than have been any of its predecessors. For the first time, it would seem, the United States has become aware of what has been going on in this specialty of medicine. The country is becoming radiation-conscious, a condition which is bound to react to the advantage of those who have practised roentgen-ray diagnosis and radiation therapy through the introductory period.